180083

FLOOD INSURANCE STUDY

TOWN OF WESTFIELD,
INDIANA
HAMILTON COUNTY

SEPTEMBER 16, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 180083

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY

TOWN OF WESTFIELD,
HAMILTON COUNTY, INDIANA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Westfield, Hamilton County, Indiana, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Town of Westfield to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Geological Survey for the Federal Insurance Administration, under Inter-Agency Agreement No. IAA-H-8-76, Project Order No. 11. This study was completed in March 1979.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of the Study Contractor, the FIA, the State of Indiana, and a representative of the Town of Westfield in November 1975. Results of the hydrologic analyses were coordinated with the U.S. Army Corps of Engineers (COE), the U.S. Department of Agriculture, Soil Conservation Service (SCS), and the State of Indiana.

On February 28, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by repre-

sentatives of the Study Contractor, the FIA, the State of Indiana, and community officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Westfield and includes a zone of extraterritorial jursidiction which surrounds the city. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through March 1984. The scope and methods of study were proposed to and agreed upon by the FIA and the Town of Westfield.

Floods caused by overflow from the following streams were studied in detail: Cool Creek from East 146th Street to East 186th Street; and Evan Kindall Drain from its mouth at Cool Creek to the Louisville Nashville Railroad upstream from U.S. Route 31. Bowman Drain and Bowman Drain Tributary were also studied in detail; however, they were deleted from this study after they were determined to have a drainage area of less than one square mile.

2.2 Community Description

The Town of Westfield is located in and completely surrounded by Hamilton County in central Indiana. The total land area contained within the town limits is 1.9 square miles. It is situated approximately 18 miles north of Indianapolis, Indiana. According to U.S. Census Bureau figures, the population has increased from 1,217 in 1960 to 1,837 in 1970 (Reference 1).

The climate in central Indiana is classified as humid continental. Average daily temperatures range from 28.3 degrees F. in winter to 75.7 degrees F in summer. Annual average precipitation of the region is 39.9 inches, and average recorded snowfall is 21.6 inches. The precipitation is fairly uniformly distributed throughout the year (Reference 2).

The area is in the Tipton Till Plain and was strongly influenced by continental glaciation. Glacial drift ranges from 20 to 120 feet thick and covers a layer of bedrock (Reference 3). Soils generally are of a moderately fine to fine-textured having a slow infiltration rate (References 4 and 5). Vegetation consists of rolling farmland with areas of wooded and brush growth (Reference 6).

The principal drainage feature of the community is Cool Creek, a tributary flowing southeasterly to the White River, which is 14.7 miles long with a

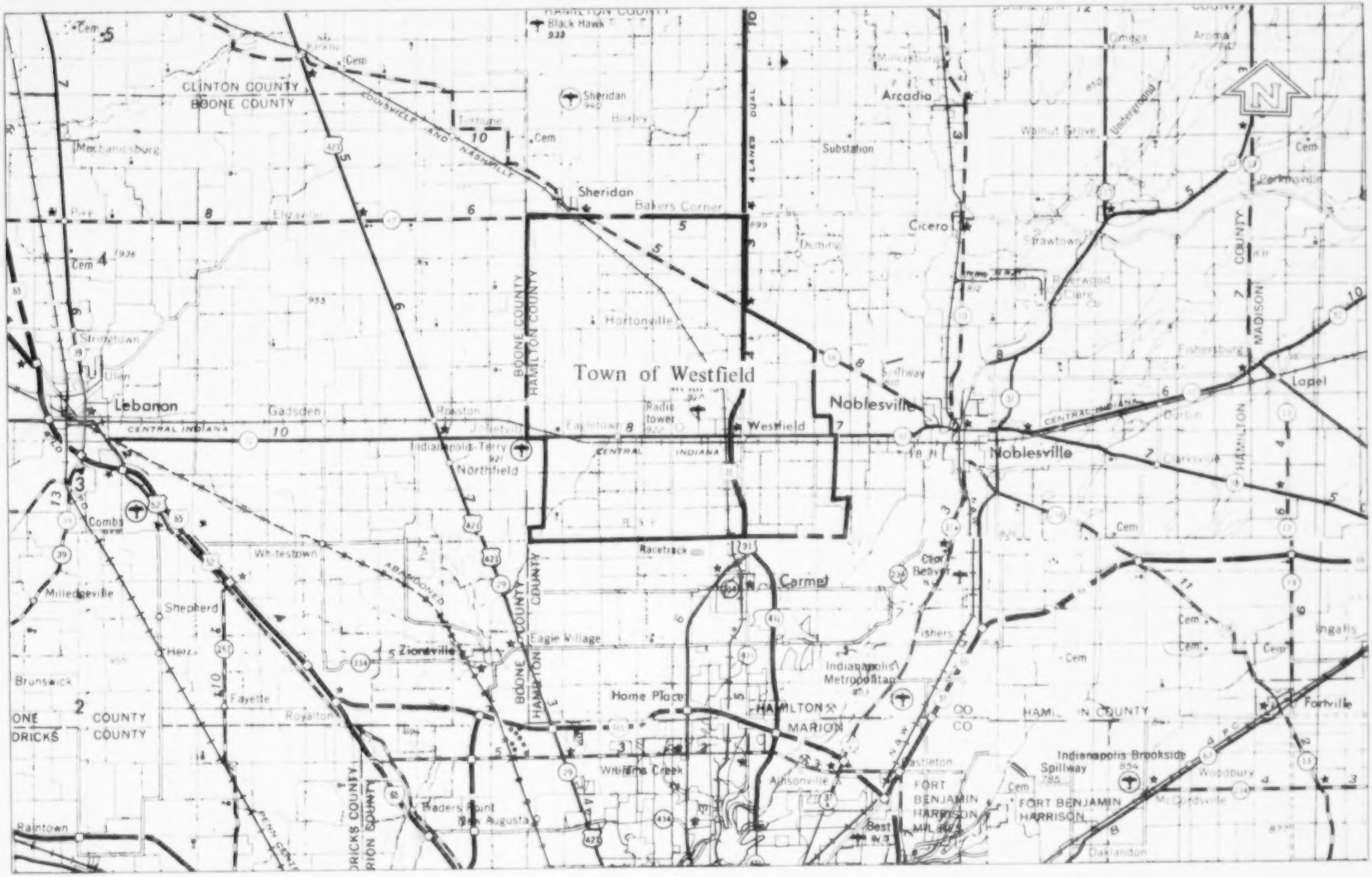


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

Federal Insurance Administration

TOWN OF WESTFIELD, IN

(HAMILTON CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

drainage area of 23.7 square miles. Evan Kindall Drain, a tributary to Cool Creek, is 3.7 miles long, with a drainage area of 3.3 square miles.

The Town of Westfield is a highly developed community surrounded by rolling farmland, with a high potential for future growth. Within the flood plains studied, development consists of private businesses, municipal buildings, and single-family residences.

2.3 Principal Flood Problems

The past history of flooding on the streams in the Town of Westfield indicates that flooding may occur during any season of the year. Floods that have occurred during the January-through-May period are usually the result of spring rains and/or snowmelt. Flooding during the summer months is often associated with thunderstorms.

There was a major flood in August 1958 in the basins studied in this report. A discharge of 1,490 cubic feet per second (cfs) was measured on Cool Creek at Oak Road 2.4 miles south of Westfield. During this flood (which was a 5 year event) water was reported to be approximately 48 inches deep in the town fire station, and Conrail at Cool Creek was washed out. The results of this study indicate that additional flooding will occur at the following locations due to undersize culverts: Cool Creek, at Conrail (river mile 10.04); and Evan Kindall Drain at Cherry Street (river mile 0.57), Conrail (river mile 0.86), and U.S. Route 31 (river mile 1.38).

Flooding will also occur along the north side of State Route 32 from Cool Creek to Hillcrest Drive, due to an overflow from Evan Kindall Drain.

2.4 Flood Protection Measures

There were no flood protection measures in the community at the time of the study.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals

or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

A combination of methods was used to define discharge-frequency data for Cool Creek and Evan Kindall Drain. The methods used include: (1) A regional relationship relating basin characteristics to streamflow characteristics (Reference 4); (2) regional relationships of streamflow, drainage area, and percentage of urbanization (Reference 5); and (3) regional relationships of peak discharge and drainage area for nearby gaging stations having similar hydrologic settings.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
COOL CREEK					
At East 151st Street	13.56	2,000	2,900	3,850	5,050
Below Evan Kindall Drain	7.23	1,280	1,850	2,420	3,250
Above Evan Kindall Drain	3.91	810	1,180	1,550	2,100
At East 186th Street	2.75	620	900	1,200	1,600
EVAN KINDALL DRAIN					
At mouth	3.32	1,300	1,900	2,400	3,150
Above Bowman Drain	2.30	540	790	1,050	1,400
At U.S. Route 31	2.00	490	720	940	1,280

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analyses were obtained from aerial photographs flown in April 1976, at a photo negative scale of 1:9600 (Reference 7). The below-water sections were obtained by field measurements. All bridges, dams and culverts were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values for the main channel ranged from 0.030 to 0.080; with flood plain roughness values ranging from 0.030 to 0.240 for all floods.

For Cool Creek, starting water-surface elevations were taken from the City of Carmel Flood Insurance Study (Reference 8). All other starting water-surface elevations were determined using backwater analysis at the parent stream.

Water-surface elevations were computed through the use of the USGS E-431 step-backwater computer program (Reference 9). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods

have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps at a scale of 1:24000, with a contour interval of 10 feet (Reference 10) and at a scale of 1:24000, with a contour interval of 2 feet (Reference 11).

All areas of approximate flooding were taken directly from Flood Prone Area maps (Reference 12).

The bou. daries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The State of Indiana, however, as set down by the Indiana Flood Control Act of 1945 and the Natural Resources Commission Policy Guidelines, Section 6, adopted March 28, 1974 (Reference 13), has designated that encroachment in the flood plain is limited to that which will cause no significant increase in flood height. As a result, no more than a 0.1-foot surcharge has been delineated for this study. The floodways shown in this report were approved by the Indiana State Natural Resources Commission when the review process was completed. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
COOL CREEK							
A	6.50	1015	3303	1.30	817.2	817.2	0.0
B	6.72	544	1314	3.27	818.9	818.9	0.0
C	7.04	900	2931	1.47	824.4	824.4	0.0
D	7.06	820	3130	1.37	824.8	824.8	0.0
E	7.14	630	1242	2.98	825.0	825.0	0.0
F	7.17	765	2975	1.24	826.4	826.4	0.0
G	7.46	681	2619	1.41	830.6	830.6	0.0
H	7.69	452	1910	1.94	835.1	835.1	0.0
I	7.87	782	3435	0.90	838.4	838.4	0.0
J	8.02	529	2085	1.34	839.7	839.7	0.0
K	8.21	660	2432	1.15	842.5	842.5	0.0
L	8.44	529	1781	1.57	844.4	844.4	0.0
M	8.59	429	1270	2.20	845.3	845.3	0.0
N	8.75	653	1832	1.53	847.1	847.1	0.0
O	8.99	445	1531	1.83	849.8	849.8	0.0
P	9.12	494	2061	1.36	851.3	851.3	0.0
Q	9.34	704	1556	1.64	852.3	852.3	0.0
R	9.49	823	1561	1.63	854.0	854.0	0.0
S	9.51	1085	2645	0.96	854.7	854.7	0.0
T	9.68	1050	2315	1.10	855.1	855.1	0.0
U	9.79	783	1395	1.83	855.8	855.8	0.0
V	9.81	898	1059	2.41	856.0	856.0	0.0
W	9.95	582	1310	1.95	857.7	857.7	0.0
X	10.02	679	1168	2.18	858.4	858.4	0.0
Y	10.05	2100	5719	0.45	863.3	863.3	0.0
Z	10.24	1579	4677	0.33	864.4	864.4	0.0

[1]MILES ABOVE MOUTH

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWN OF WESTFIELD, IN
(HAMILTON CO.)

FLOODWAY DATA

COOL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
COOL CREEK							
AA	10.53	1079	2847	0.54	864.4	864.4	0.0
AB	10.75	638	1807	0.86	864.6	864.6	0.0
AC	11.14	439	874	1.77	866.9	866.9	0.0
AD	11.39	601	1606	0.96	867.8	867.8	0.0
AE	11.63	469	819	1.59	868.6	868.6	0.0
AF	11.86	629	1425	0.91	869.9	869.9	0.0
EVAN KINDALL DRAIN							
A	0.29	409	1835	1.31	868.4	868.4	0.0
B	0.39	336	958	2.50	868.9	868.9	0.0
C	0.49	301	1138	2.11	870.3	870.3	0.0
D	0.65	241	1090	2.11	874.7	874.7	0.0
E	0.74	160	506	4.54	876.9	876.9	0.0
F	0.91	506	2624	0.40	884.2	884.2	0.0
G	1.16	301	1103	0.95	884.3	884.3	0.0
H	1.31	288	667	1.57	885.4	885.4	0.0
I	1.45	687	2525	0.37	893.7	893.7	0.0

[1]MILES ABOVE MOUTH

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWN OF WESTFIELD, IN
(HAMILTON CO.)

FLOODWAY DATA

COOL CREEK - EVAN KINDALL DRAIN

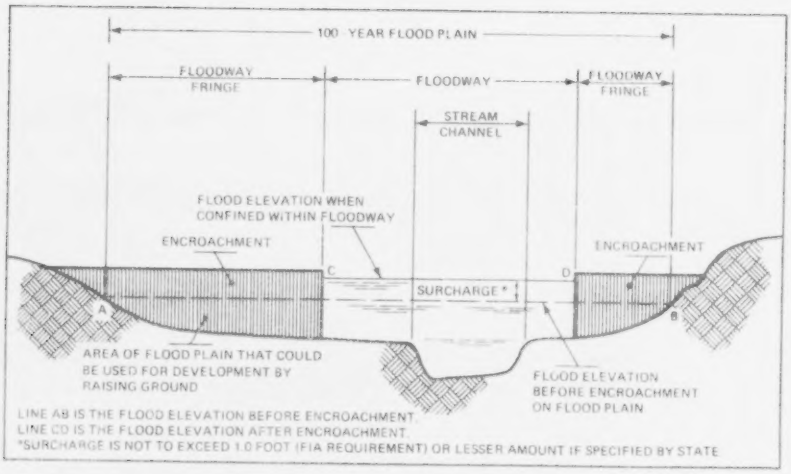

100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the Town of Westfield.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the Town of Westfield are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire study area of the Town of Westfield was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A1, A2, A4 and A12:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of Westfield is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

A Flood Insurance Study is currently being conducted for the City of Carmel, which borders the extraterritorial jurisdiction of Westfield on the south, and for Hamilton County which encompasses this study (References 8 and 14). The results of these studies will match this study exactly. No other studies were found to exist at the time of the report.

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 15). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602 .

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
COOL CREEK							
REACH 1	0010,0011,0014 0015,0017	–1.1	–0.5	0.6	010	A2	VARIES–SEE MAP
EVAN KINDALL DRAIN							
REACH 1	0014	–0.8	–0.3	0.4	010	A2	VARIES–SEE MAP
REACH 2	0014	–1.8	–0.6	0.6	020	A4	VARIES–SEE MAP
REACH 3	0014	–0.5	–0.3	0.3	005	A1	VARIES–SEE MAP
REACH 4	0014	–6.1	–3.3	1.7	060	A12	VARIES- SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWN OF WESTFIELD, IN
(HAMILTON CO.)

FLOOD INSURANCE ZONE DATA

COOL CREEK - EVAN KINDALL DRAIN

8.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Department of Commerce, Bureau of Census, 1970 Census of Population, Indiana, PC(V1)-16, December 1970.

2. ----------, National Oceanic and Atmospheric Administration, Environmental Data Service, Local Climatological Data Annual Summary with Comparative Data 1977, Indianapolis, Indiana.

3. Lindsey, A.A., Natural Features of Indiana, 1966.

4. U.S. Geological Survey, Circular No. 710, Floods of Indiana, Technical Manual for Estimating their Magnitude and Frequency, L.G. Davis, 1974.

5. U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, January 1975.

6. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: Carmel, Indiana, 1973.

7. Mid-States Engineering Co., Inc., Indianapolis Indiana, Aerial Photographs, Scale 1:9600: Westfield, Indiana, April 1976.

8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Carmel, Indiana, (in progress).

9. U.S. Geological Survey, Open-File Report 76-499, Computer Applications for Step-Backwater and Floodway Analyses Users' Manual, J. O. Shearman, 1976.

10. ----------, Flood Prone Area Maps, Scale 1:24000, Contour Interval 10 feet: Noblesville, Indiana, 1969, Westfield, Indiana, 1969.

11. Indiana Department of Natural Resources, Flood Plain (Topographic) Maps, Scale 1:2400, Contour Interval two feet: 1976.

12. U.S. Geological Survey, Flood Prone Area Maps, Scale 1:24000, Contour Interval 10 feet: Noblesville, Indiana, 1974, Westfield, Indiana, 1973.

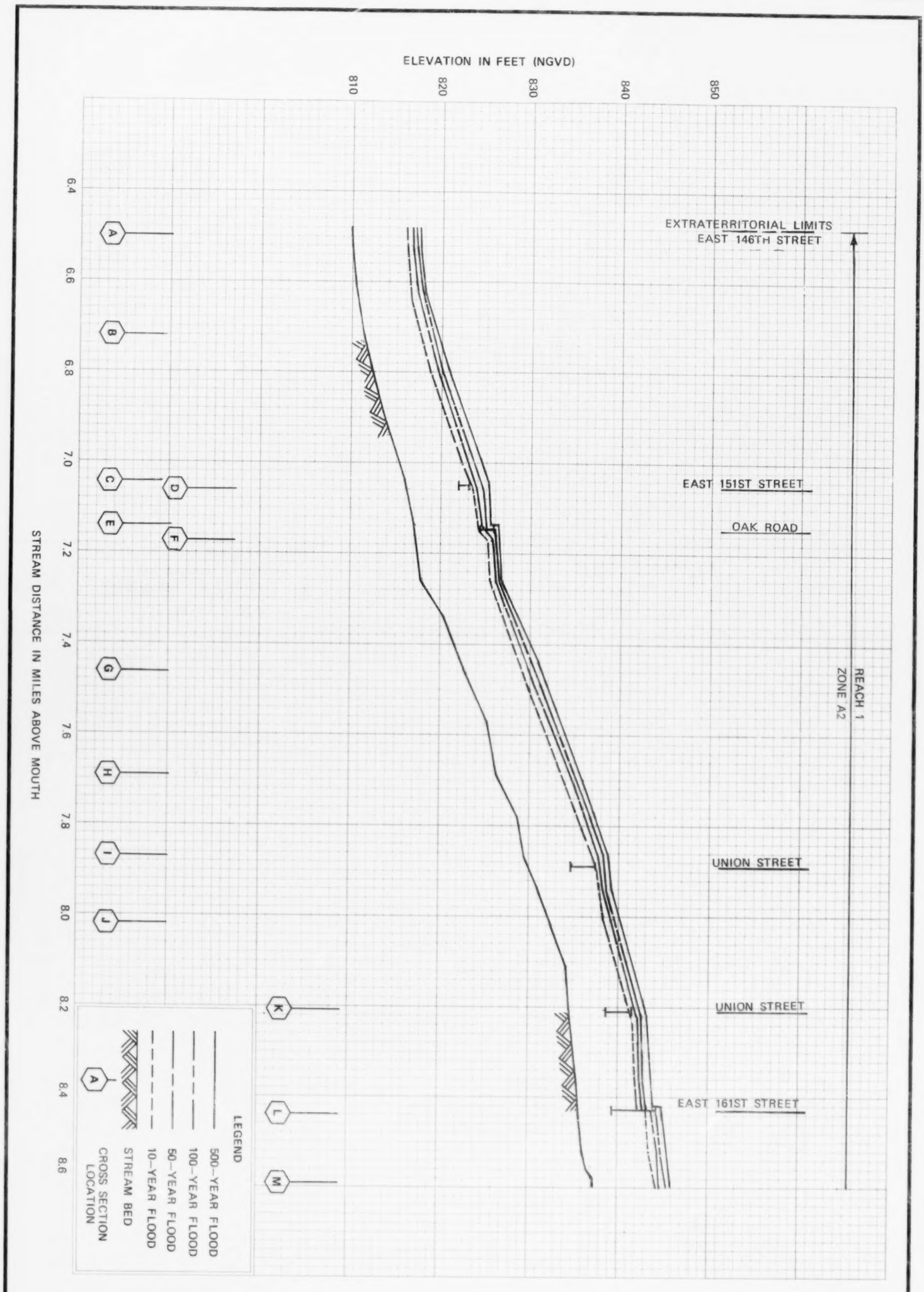
13. Indiana Department of Natural Resources, Guidelines for Delineation of Floodways and Flood Hazard Areas, March 28, 1974.

14. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Hamilton County, Unincorporated Areas, Indiana, (in progress).

15. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Town of Westfield, Indiana, May 1976.

State of Indiana, Natural Resources Commission, Flood Plain Management Rule-1, Guidelines for Delineation of Floodways and Flood Hazard Areas, March 1974.

U.S. Water Resources Council, Bulletin No. 17, Hydrology Committee, Guidelines for Determining Flood Flow Frequency, March 1976.



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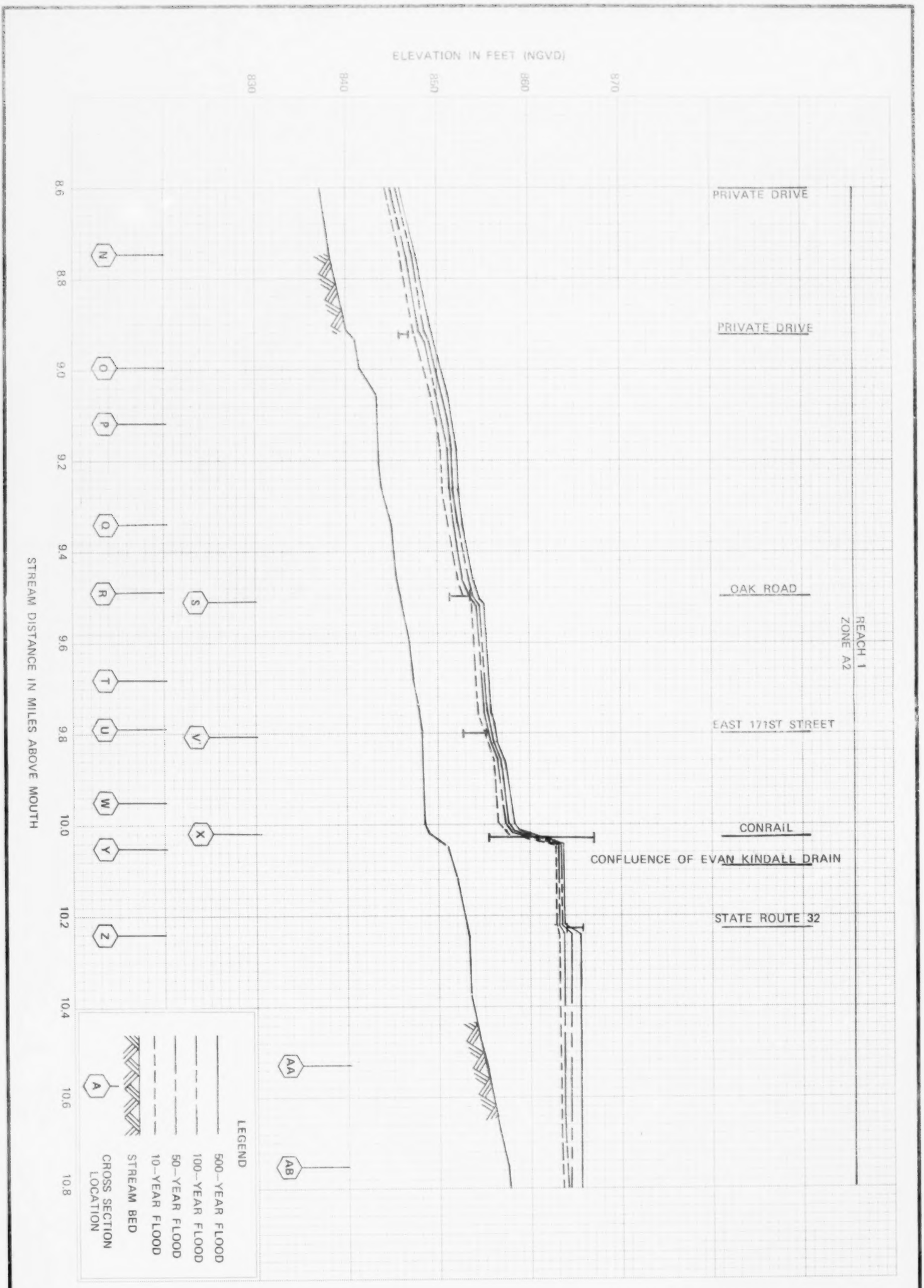
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWN OF WESTFIELD, IN
(HAMILTON CO.)

FLOOD PROFILES

COOL CREEK



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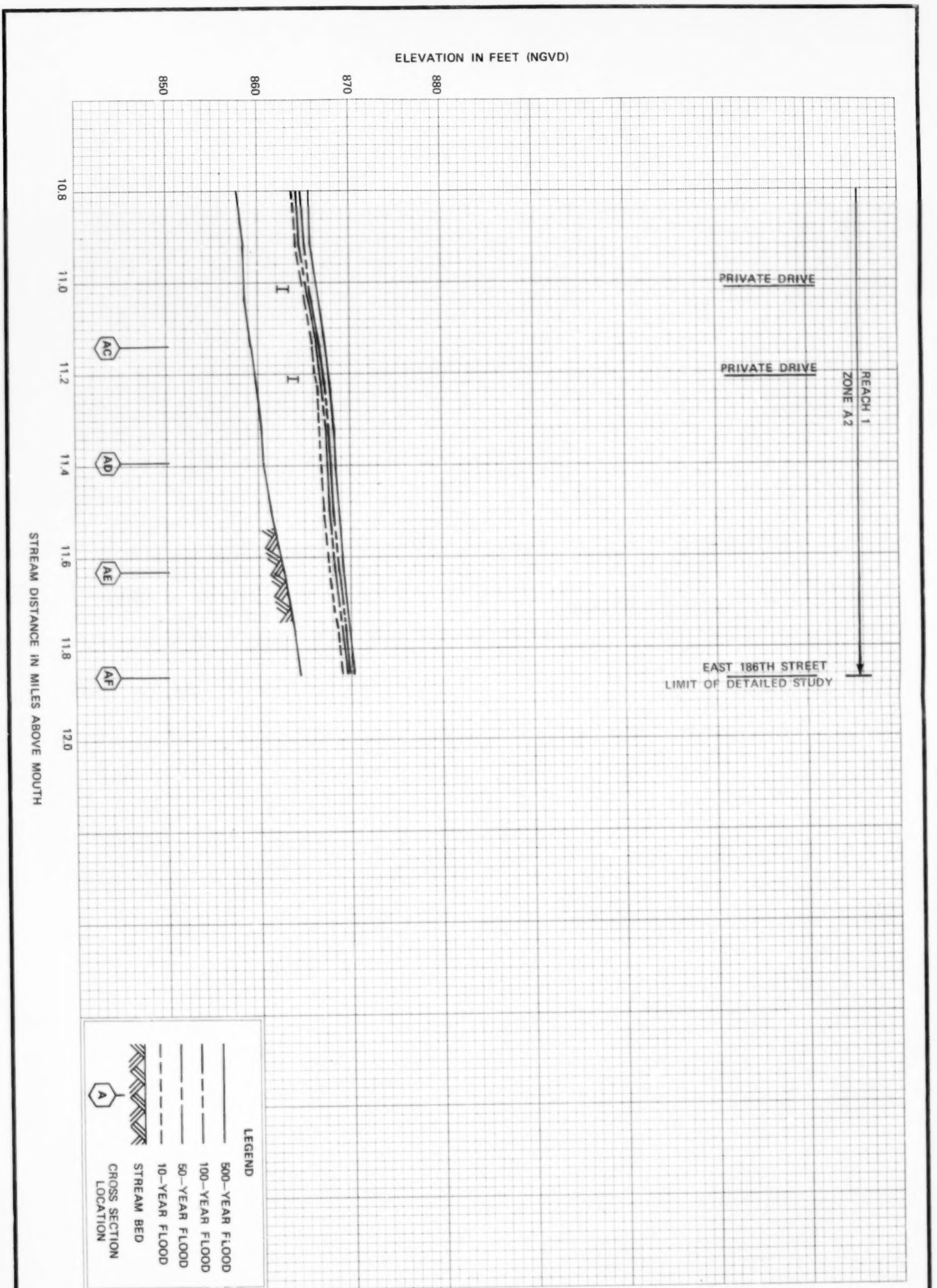
02P



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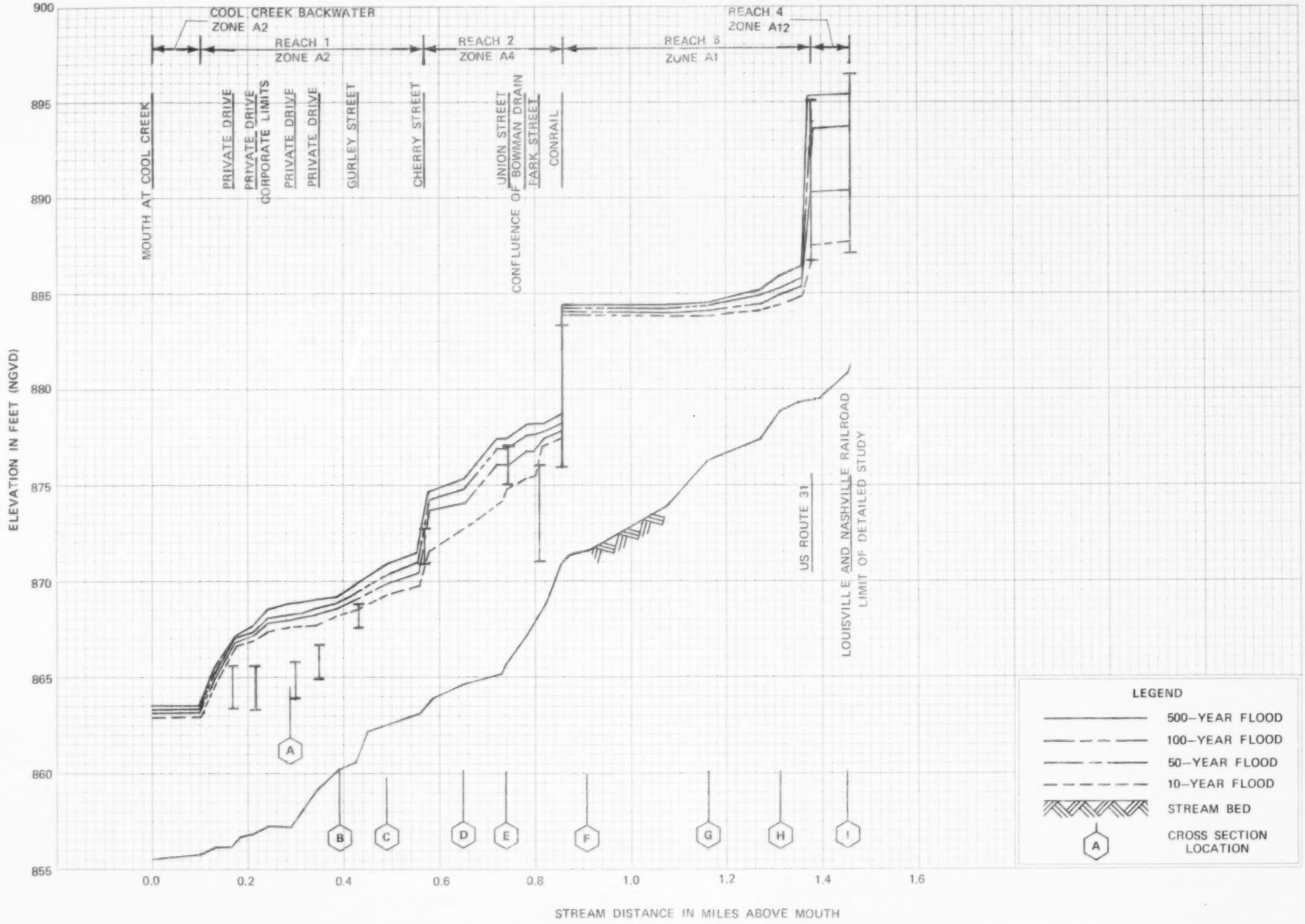

FLOOD PROFILES

EVAN KINDALL DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF WESTFIELD, IN
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